PART 70 MINOR SOURCE MODIFICATION
OFFICE OF AIR QUALITY

Eli Lilly and Company - Tippecanoe Laboratories
1650 Lilly Road
Lafayette, Indiana 47909

(herein known as the Permittee) is hereby authorized to construct and operate subject to the conditions contained herein, the emission units described in Section A (Source Summary) of this approval.

This approval is issued in accordance with 326 IAC 2 and 40 CFR Part 70 Appendix A and contains the conditions and provisions specified in 326 IAC 2-7 as required by 42 U.S.C. 7401, et. seq. (Clean Air Act as amended by the 1990 Clean Air Act Amendments), 40 CFR Part 70.6, IC 13-15 and IC 13-17.

Minor Source Modification No.: 157-15636-00006	
Issued by: Original signed by Paul Dubenetzky Paul Dubenetzky, Branch Chief Office of Air Quality	Issuance Date: August 8, 2002

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SECTION A   **SOURCE SUMMARY**

This approval is based on information requested by the Indiana Department of Environmental
Management (IDEM), Office of Air Quality (OAQ). The information describing the emission units
contained in conditions A.1 through A.2 is descriptive information and does not constitute enforceable
conditions. However, the Permittee should be aware that a physical change or a change in the method
of operation that may render this descriptive information obsolete or inaccurate may trigger requirements
for the Permittee to obtain additional permits or seek modification of this approval pursuant to 326 IAC 2,
or change other applicable requirements presented in the permit application.

A.1   General Information [326 IAC 2-7-4(c)] [326 IAC 2-7-5(15)]
               The Permittee owns and operates a stationary source that produces pharmaceutical products.

Responsible Official:	Kenny McCleary
Source Address:	1650 Lilly Road, Lafayette, Indiana 47909
Mailing Address:	1650 Lilly Road, Lafayette, Indiana 47909
General Source Phone Number:	765-477-4006
SIC Code:	2834 and 2879
County Location:	Tippecanoe
Source Location Status:	Attainment for all criteria pollutants
Source Status:	Part 70 Permit Program
	Major Source, under PSD or Emission Offset Rules;
	Major Source, Section 112 of the Clean Air Act
	1 of 28 Source Categories

A.2   Emission Units and Pollution Control Equipment Summary [326 IAC 2-7-4(c)(3)]
               [326 IAC 2-7-5(15)]
               This stationary source is approved to construct and operate the following emission units and
               pollution control devices:

           (a)   Replacement Tanks:
                   (1)   One (1) Process Vessel, identified as REAC 3205 to be installed in building T29
                            with a capacity of 2,000 gallons. The existing Tank REAC 3205 is a 2,000 gallon
                            glassed lined tank that will be replaced by exactly similar glassed lined tank; and

                   (2)   One (1) Still Tank, identified as # 613 to be installed in building T31 with a
                            capacity of 500 gallons. The existing Still Tank 613 is a 500 gallon stainless
                            steel tank that will be replaced by a 500 gallon Hastelloy tank.

               The point source emissions from these process vessels may vent directly to the RTO, or they
               may first vent to scrubbers, process control condensers, vacuum sources, or through other
               process vessels before going to the RTO. If venting the process vessel to the RTO would cause
               a safety concern, the process vessels may vent to an alternative pollution control device.

               SO2 and NOx emissions are voluntarily controlled by scrubbers. CO emissions will be voluntarily
               vented to the RTOs. No emission limits on SO2, NOx, or CO are needed.

A.3   Specifically Regulated Insignificant Activities [326 IAC 2-7-1(21)] [326 IAC 2-7-4(c)]
               Part 70 Permit Applicability [326 IAC 2-7-2]
               This stationary source is required to have a Part 70 permit by 326 IAC 2-7-2 (Applicability)
               because:

           (a)   It is a major source, as defined in 326 IAC 2-7-1(22);

           (b)   It is a source in a source category designated by the United States Environmental
                   Protection Agency (U.S. EPA) under 40 CFR 70.3 (Part 70 - Applicability).

SECTION B   **GENERAL CONSTRUCTION CONDITIONS**

B.1   Definitions [326 IAC 2-7-1]
　　　　Terms in this permit shall have the definition assigned to such terms in the referenced regulation. In the absence of definitions in the referenced regulation, the applicable definitions found in the statutes or regulations (IC 13-11, 326 IAC 1-2 and 326 IAC 2-7) shall prevail.

B.2   Effective Date of the Permit [IC13-15-5-3]
　　　　Pursuant to IC 13-15-5-3, this approval becomes effective upon its issuance.

B.3   Revocation of Permits [326 IAC 2-1.1-9(5)][326 IAC 2-7-10.5(i)]
　　　　Pursuant to 326 IAC 2-1.1-9(5)(Revocation of Permits), the Commissioner may revoke this approval if construction is not commenced within eighteen (18) months after receipt of this approval or if construction is suspended for a continuous period of one (1) year or more.

SECTION C   **GENERAL OPERATION CONDITIONS**

C.1   Certification [326 IAC 2-7-4(f)][326 IAC 2-7-6(1)][326 IAC 2-7-5(3)(C)]

(a)   Where specifically designated by this permit or required by an applicable requirement, any application form, report, or compliance certification submitted shall contain certification by a responsible official of truth, accuracy, and completeness. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

(b)   One (1) certification shall be included, using the attached Certification Form, with each submittal requiring certification.

(c)   A responsible official is defined at 326 IAC 2-7-1(34).

C.2   Preventive Maintenance Plan [326 IAC 2-7-5(1),(3) and (13)] [326 IAC 2-7-6(1) and (6)] [326 IAC 1-6-3]

(a)   If required by specific condition(s) in Section D of this permit, the Permittee shall prepare and maintain Preventive Maintenance Plans (PMPs) when operation begins, including the following information on each facility:

(1)   Identification of the individual(s) responsible for inspecting, maintaining, and repairing emission control devices;

(2)   A description of the items or conditions that will be inspected and the inspection schedule for said items or conditions; and

(3)   Identification and quantification of the replacement parts that will be maintained in inventory for quick replacement.

If, due to circumstances beyond the Permittee's control, the PMPs cannot be prepared and maintained within the above time frame, the Permittee may extend the date an additional ninety (90) days provided the Permittee notifies:

Indiana Department of Environmental Management
Compliance Branch, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

The PMP and the PMP extension notification do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(b)   The Permittee shall implement the PMPs as necessary to ensure that failure to implement a PMP does not cause or contribute to a violation of any limitation on emissions or potential to emit.

(c)   A copy of the PMPs shall be submitted to IDEM, OAQ, upon request and within a reasonable time, and shall be subject to review and approval by IDEM, OAQ. IDEM, OAQ, may require the Permittee to revise its PMPs whenever lack of proper maintenance causes or contributes to any violation. The PMP does not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(d)   Records of preventive maintenance shall be retained for a period of at least five (5) years. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.

C.3   Permit Amendment or Modification [326 IAC 2-7-11] [326 IAC 2-7-12]
        (a)   Permit amendments and modifications are governed by the requirements of 326 IAC 2-7-
                11 or 326 IAC 2-7-12 whenever the Permittee seeks to amend or modify this permit.

        (b)   Any application requesting an amendment or modification of this permit shall be
                submitted to:

                Indiana Department of Environmental Management
                Permits Branch, Office of Air Quality
                100 North Senate Avenue, P.O. Box 6015
                Indianapolis, Indiana 46206-6015

                Any such application shall be certified by the "responsible official" as defined by
                326 IAC 2-7-1(34).

        (c)   The Permittee may implement administrative amendment changes addressed in the
                request for an administrative amendment immediately upon submittal of the request. [326
                IAC 2-7-11(c)(3)]

C.4   Opacity [326 IAC 5-1]
        Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary
        Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in this
        permit:

        (a)   Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute
                averaging period as determined in 326 IAC 5-1-4.

        (b)   Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen
                (15) minutes (sixty (60) readings as measured according to 40 CFR 60, Appendix A,
                Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a
                continuous opacity monitor) in a six (6) hour period.

C.5   Operation of Equipment [326 IAC 2-7-6(6)]
        Except as otherwise provided by statute or rule, or in this permit, all air pollution control
        equipment listed in this permit and used to comply with an applicable requirement shall be
        operated at all times that the emission units vented to the control equipment are in operation.

Testing Requirements [326 IAC 2-7-6(1)]

C.6   Performance Testing [326 IAC 3-6][326 IAC 2-1.1-11]
        (a)   Compliance testing on new emission units shall be conducted within 60 days after
                achieving maximum production rate, but no later than 180 days after initial start-up, if
                specified in Section D of this approval. All testing shall be performed according to the
                provisions of 326 IAC 3-6 (Source Sampling Procedures), except as provided elsewhere
                in this approval, utilizing any applicable procedures and analysis methods specified in 40
                CFR 51, 40 CFR 60, 40 CFR 61, 40 CFR 63, 40 CFR 75, or other procedures approved
                by IDEM, OAQ.

                A test protocol, except as provided elsewhere in this approval, shall be submitted to:

                Indiana Department of Environmental Management

Compliance Data Section, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

no later than thirty-five (35) days prior to the intended test date. The protocol submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(b)   The Permittee shall notify IDEM, OAQ of the actual test date at least fourteen (14) days prior to the actual test date. The notification submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(c)   Pursuant to 326 IAC 3-6-4(b), all test reports must be received by IDEM, OAQ within forty-five (45) days after the completion of the testing. An extension may be granted by IDEM, OAQ, if the source submits to IDEM, OAQ, a reasonable written explanation within five (5) days prior to the end of the initial forty-five (45) day period. The test report submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

Compliance Requirements [326 IAC 2-1.1-11]

C.7   Compliance Requirements [326 IAC 2-1.1-11]
The commissioner may require stack testing, monitoring, or reporting at any time to assure compliance with all applicable requirements. Any monitoring or testing shall be performed in accordance with 326 IAC 3 or other methods approved by the commissioner or the U. S. EPA.

Compliance Monitoring Requirements [326 IAC 2-7-5(1)] [326 IAC 2-7-6(1)]

C.8   Compliance Monitoring [326 IAC 2-7-5(3)] [326 IAC 2-7-6(1)]
If required by Section D, all monitoring and record keeping requirements shall be implemented when operation begins. The Permittee shall be responsible for installing any necessary equipment and initiating any required monitoring related to that equipment.

Corrective Actions and Response Steps [326 IAC 2-7-5] [326 IAC 2-7-6]

C.9   Actions Related to Noncompliance Demonstrated by a Stack Test [326 IAC 2-7-5]
[326 IAC 2-7-6]
(a)   When the results of a stack test performed in conformance with Section C - Performance Testing, of this approval exceed the level specified in any condition of this approval, the Permittee shall take appropriate response actions. The Permittee shall submit a description of these response actions to IDEM, OAQ, within thirty (30) days of receipt of the test results. The Permittee shall take appropriate action to minimize excess emissions from the affected facility while the response actions are being implemented.

(b)   A retest to demonstrate compliance shall be performed within one hundred twenty (120) days of receipt of the original test results. Should the Permittee demonstrate to IDEM, OAQ that retesting in one-hundred and twenty (120) days is not practicable, IDEM, OAQ may extend the retesting deadline.

(c)   IDEM, OAQ reserves the authority to take any actions allowed under law in response to noncompliant stack tests.

The documents submitted pursuant to this condition do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

Record Keeping and Reporting Requirements [326 IAC 2-7-5(3)] [326 IAC 2-7-19]

C.10   Malfunctions Report [326 IAC 1-6-2]
        Pursuant to 326 IAC 1-6-2 (Records; Notice of Malfunction):

(a)   A record of all malfunctions, including startups or shutdowns of any facility or emission control equipment, which result in violations of applicable air pollution control regulations or applicable emission limitations shall be kept and retained for a period of three (3) years and shall be made available to the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ) or appointed representative upon request.

(b)   When a malfunction of any facility or emission control equipment occurs which lasts more than one (1) hour, said condition shall be reported to OAQ, using the Malfunction Report Forms (2 pages) or equivalent. Notification shall be made by telephone or facsimile, as soon as practicable, but in no event later than four (4) daytime business hours after the beginning of said occurrence.

(c)   For malfunction lasting more than one (1) hour - failure to report a malfunction of any emission control equipment shall constitute a violation of 326 IAC 1-6, and any other applicable rules. Information of the scope and expected duration of the malfunction shall be provided, including the items specified in 326 IAC 1-6-2(a)(1) through (6).

(d)   Malfunction is defined as any sudden, unavoidable failure of any air pollution control equipment, process, or combustion or process equipment to operate in a normal and usual manner. [326 IAC 1-2-39]

C.11   General Record Keeping Requirements [326 IAC 2-7-5(3)][326 IAC 2-7-6]
(a)   Records of all required data, reports and support information shall be retained for a period of at least five (5) years from the date of monitoring sample, measurement, report, or application. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.

(b)   Unless otherwise specified in this permit, all record keeping requirements not already legally required shall be implemented upon start of operation.

SECTION D.1   FACILITY OPERATION CONDITIONS

Facility Description [326 IAC 2-7-5(15)]
(a)   Replacement Tanks:
    (1)   One (1) Process Vessel, identified as REAC 3205 to be installed in building T29
        with a capacity of 2,000 gallons. The existing Tank REAC 3205 is a 2,000 gallon
        glassed lined tank that will be replaced by exactly similar glassed lined tank; and

    (2)   One (1) Still Tank, identified as # 613 to be installed in building T31 with a capacity of
        500 gallons. The existing Still Tank 613 is a 500 gallon stainless steel tank that will be
        replaced by a 500 gallon Hastelloy tank.

The point source emissions from these process vessels may vent directly to the RTO, or they
may first vent to scrubbers, process control condensers, vacuum sources, or through other
process vessels before going to the RTO. If venting the process vessel to the RTO would
cause a safety concern, the process vessels may vent to an alternative pollution control
device.

    SO2 and NOx emissions are voluntarily controlled by scrubbers. CO emissions will be
    voluntarily vented to the RTOs. No emission limits on SO2, NOx, or CO are needed.

(The information describing the process contained in this facility description box is descriptive
information and does not constitute enforceable conditions.)

SECTION D.1   FACILITY OPERATION CONDITIONS

Emission Limitations and Standards

D.1.1   Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing [326 IAC 8-5-3]
    (a)   Pursuant to 326 IAC 8-5-3 when using condensers to control the VOC emissions from
        these process tanks, REAC 3205 and Still Tank # 613 the outlet gas temperature shall
        not exceed the following:

        (1)   minus twenty-five degrees Celsius (-25 ^{0}C) when condensing VOC of vapor
            pressure greater than forty (40) kilo Pascals (five and eight-tenths (5.8) pounds
            per square inch);

        (2)   minus fifteen degrees Celsius (-15 ^{0}C) when condensing VOC of vapor pressure
            greater than twenty (20) kilo Pascals (two and nine-tenths (2.9) pounds per
            square inch);

        (3)   zero degrees Celsius (0 ^{0}C) when condensing VOC of vapor pressure greater
            than ten (10) kilo Pascals (one and five-tenths (1.5) pounds per square inch);

        (4)   ten degrees Celsius (10 ^{0}C) when condensing VOC of vapor pressure greater
            than seven (7) kilo Pascals (one (1) pounds per square inch); or

        (5)   twenty -five degrees Celsius (25 ^{0}C) when condensing VOC of vapor pressure
            greater than three and five-tenths (3.5) kilo Pascals (five-tenths (0.5) pounds per
            square inch).

    (b)   Pursuant to 326 IAC 8-5-3(b)(1)(C), when using equivalent controls, the VOC emissions
        shall be reduced by at least as much as they would be by using a surface condenser

   which meets the requirements of conditions (a)(1) through (a)(5) as applicable. The
   approximate equivalent control efficiency for the RTO is 90%.

 (c) Pursuant to 326 IAC 8-5-3(b)(5) the Permittee shall install covers on all in process tanks
   that contain VOCs. These covers shall be kept closed unless production sampling,
   maintenance, or inspection procedures require operator access.

 (d) Pursuant to 326 IAC 8-5-3(b)(6) the Permittee shall repair all visible leaks from which a
   liquid, containing VOC can be observed running or dripping. The repair shall be
   completed the first time the equipment is off line for a period of time long enough to
   complete the repair.

D.1.2 National Emission Standards for Hazardous Air Pollutants (NESHAPs) 40 CFR Part 63,
   Subparts I and H
   The owner or operator shall implement the Lilly Leak Detection and Repair (LDAR) Program,
   most recently approved by the Office of Air Quality, to reduce fugitive emissions from processes
   that use methylene chloride. If it is not feasible to either pressure test a group of fugitive sources
   or monitor a specific compound, then a written justification shall be required for each source or
   compound exempted from testing. Any necessary adjustments to the procedures shall be
   submitted to the Office of Air Quality for approval prior to implementation.

D.1.3 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production)
   The new process tanks REAC 3205 and Still Tank # 613 installation does not constitute a new or
   reconstruction of the affected source under Subpart GGG, nor do they constitute a new or
   reconstruction of a pharmaceutical manufacturing process unit (PMPU). Therefore, the existing
   source requirements of Subpart GGG shall apply, (see the attached rule).

Compliance Determination Requirements

D.1.4 Testing Requirements [326 IAC 2-7-6(1),(6)][326 IAC 2-1.1-11]
   The Permittee is not required to test the facilities by this permit. The testing required for these
   facilities will be deferred and shall follow the schedule in the Title V Permit, to determine
   compliance with 326 IAC 8-5-3. However, IDEM may require compliance testing when necessary
   to determine if the facilities are in compliance. If testing is required by IDEM compliance with
   Condition D.1.1 shall be determined by a performance test conducted in accordance with Section
   C - Performance Testing.

D.1.5 Monitoring For VOC Emissions
 (a) The VOC emissions from the new process tanks REAC 3205 and Still Tank # 613 shall
   be in compliance with 326 IAC 8-5-3 provided that:

  (1) the Regenerative Thermal Oxidizers (RTO1 or RTO2) or Condensers (when Lilly
    elects to control the VOC by condensers) shall operate at all times the equipment
    being controlled are in operation and emitting VOC;

  (2) when the VOC emissions from the proposed process tanks REAC 3205 and Still
    Tank # 613 are controlled by RTO1 or RTO2, the RTOs operating temperature
    shall maintain a minimum operating temperature determined by a performance
    tests to maintain at least 90% destruction of the volatile organic compounds.
    Until a performance test is performed the combustion chamber shall maintain a
    minimum operating temperature of 1600 ^{0}F. The operating temperature of the
    exhaust of the RTOs shall be continuously recorded whenever they are
    operating.

     (3)   when the VOC emissions from the proposed process tanks REAC 3205 and Still Tank # 613 are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3, see condition D.1.1;

Record Keeping and Reporting Requirements

D.1.6   Record Keeping Requirements

     (a)   The Permittee shall maintain records as follows:

         (1)   The malfunction report of the RTOs; and applicable malfunction reports when the facility is emitting VOC, but not venting to the RTOs;

         (2)   Continuous records of the operating temperature of the RTOs during normal operation when process tanks REAC 3205 and Still Tank # 613 are emitting VOC;

         (3)   The number of hours the proposed process tanks REAC 3205 and Still Tank # 613 were emitting VOC and vented to points other than the RTO or the condenser;

         (4)   The Permittee records the time during which the proposed process tanks REAC 3205 and Still Tank # 613 were emitting VOC but the RTO or condensers, serving the proposed process tanks, were not operated;

         (5)   The Permittee records the reason the RTO or condensers were not operated during the period referred to in (4);

         (6)   The Permittee records the corrective actions taken to bring the RTO or condensers to normal operation during the period referred to in (4).

     (b)   All records shall be maintained in accordance with Section C - General Record Keeping Requirements, of this permit.

MALFUNCTION REPORT

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Air Quality
FAX NUMBER - 317 233-5967

**This form should only be used to report malfunctions applicable to Rule 326 IAC 1-6
and to qualify for the exemption under 326 IAC 1-6-4.**

THIS FACILITY MEETS THE APPLICABILITY REQUIREMENTS BECAUSE IT HAS POTENTIAL TO EMIT 25 TONS/YEAR PARTICULATE MATTER ?_____, 25 TONS/YEAR SULFUR DIOXIDE ?_____, 25 TONS/YEAR NITROGEN OXIDES?_____, 25 TONS/YEAR VOC ?_____, 25 TONS/YEAR HYDROGEN SULFIDE ?_____, 25 TONS/YEAR TOTAL REDUCED SULFUR ?_____, 25 TONS/YEAR REDUCED SULFUR COMPOUNDS ?_____, 25 TONS/YEAR FLUORIDES ?_____, 100 TONS/YEAR CARBON MONOXIDE ?_____, 10 TONS/YEAR ANY SINGLE HAZARDOUS AIR POLLUTANT ?_____, 25 TONS/YEAR ANY COMBINATION HAZARDOUS AIR POLLUTANT ?_____, 1 TON/YEAR LEAD OR LEAD COMPOUNDS MEASURED AS ELEMENTAL LEAD ?_____, OR IS A SOURCE LISTED UNDER 326 IAC 2-5.1-3(2) ?_____. EMISSIONS FROM MALFUNCTIONING CONTROL EQUIPMENT OR PROCESS EQUIPMENT CAUSED EMISSIONS IN EXCESS OF APPLICABLE LIMITATION _____.

THIS MALFUNCTION RESULTED IN A VIOLATION OF: 326 IAC _____ OR, PERMIT CONDITION # _____ AND/OR PERMIT LIMIT OF _____

THIS INCIDENT MEETS THE DEFINITION OF 'MALFUNCTION' AS LISTED ON REVERSE SIDE ?   Y   N

THIS MALFUNCTION IS OR WILL BE LONGER THAN THE ONE (1) HOUR REPORTING REQUIREMENT ?   Y   N

COMPANY:_Eli Lilly and Company - Tippecanoe Laboratories_ _____PHONE NO. (765) 477-5138_____
LOCATION: (CITY AND COUNTY)__Lafayette, Tippecanoe_____
PERMIT NO. _MSM 157-15636_____ AFS PLANT ID: ___157-00006_____ AFS POINT ID: _____ INSP:_____
CONTROL/PROCESS DEVICE WHICH MALFUNCTIONED AND REASON:_____
_____

DATE/TIME MALFUNCTION STARTED: _____/_____/ 20____ _____ AM / PM

ESTIMATED HOURS OF OPERATION WITH MALFUNCTION CONDITION: _____

DATE/TIME CONTROL EQUIPMENT BACK-IN SERVICE_____/_____/ 20____ _____ AM/PM

TYPE OF POLLUTANTS EMITTED: TSP, PM-10, SO2, VOC, OTHER:_____

ESTIMATED AMOUNT OF POLLUTANT EMITTED DURING MALFUNCTION: _____

MEASURES TAKEN TO MINIMIZE EMISSIONS:_____

REASONS WHY FACILITY CANNOT BE SHUTDOWN DURING REPAIRS:

CONTINUED OPERATION REQUIRED TO PROVIDE UNDERLINE* SERVICES:_____
CONTINUED OPERATION NECESSARY TO PREVENT INJURY TO PERSONS:_____
CONTINUED OPERATION NECESSARY TO PREVENT SEVERE DAMAGE TO EQUIPMENT:_____
INTERIM CONTROL MEASURES: (IF APPLICABLE)_____
_____ __
MALFUNCTION REPORTED BY:_____TITLE:_____
                                      (SIGNATURE IF FAXED)

MALFUNCTION RECORDED BY:_____DATE:_____TIME:_____
*SEE PAGE 2

PAGE 1 OF 2

**Please note - This form should only be used to report malfunctions
applicable to Rule 326 IAC 1-6 and to qualify for
the exemption under 326 IAC 1-6-4.**

326 IAC 1-6-1 Applicability of rule

Sec. 1. This rule applies to the owner or operator of any facility required to obtain a permit under 326 IAC 2-5.1 or 326 IAC 2-6.1.

326 IAC 1-2-39 "Malfunction" definition

Sec. 39. Any sudden, unavoidable failure of any air pollution control equipment, process, or combustion or process equipment to operate in a normal and usual manner.

*Essential services are interpreted to mean those operations, such as, the providing of electricity by power plants. Continued operation solely for the economic benefit of the owner or operator shall not be sufficient reason why a facility cannot be shutdown during a control equipment shutdown.

If this item is checked on the front, please explain rationale:

_____

_____

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY
COMPLIANCE DATA SECTION

PART 70 SOURCE MODIFICATION
CERTIFICATION

Source Name: Eli Lilly and Company - Tippecanoe Laboratories
Source Address: 1650 Lilly Road, Lafayette, Indiana 47905
Mailing Address: P.O. Box 685, Lafayette, Indiana 47902
Source Modification No.:   157-15636-00006

This certification shall be included when submitting monitoring, testing reports/results or other documents as required by this approval.

Please check what document is being certified:

9   Test Result (specify) _____

9   Report (specify)   _____

9   Notification (specify)   _____

9   Affidavit (specify)   _____

9   Other (specify)   _____

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

Signature:
Printed Name:
Title/Position:
Date:

Indiana Department of Environmental Management
Office of Air Quality

Technical Support Document (TSD) for a Minor Source Modification

Source Background and Description

Source Name:	Eli Lilly and Company - Tippecanoe Laboratories
Source Location:	1650 Lilly Road, Lafayette, Indiana 47909
County:	Tippecanoe
SIC Code:	2834 & 2879
Operation Permit No.:	TV157-6879-00006 Issuance Date: Pending
Minor Source Modification No.:	157-15636-00006
Permit Reviewer:	Aida De Guzman

The Office of Air Quality (OAQ) has reviewed an application from Eli Lilly and Company relating to the construction and operation of the following replacement process tanks to be used in a variety of operations involved in pharmaceutical manufacturing:

(a)   Replacement Tanks:
   (1)   One (1) Process Vessel, identified as REAC 3205 to be installed in building T29 with a capacity of 2,000 gallons. The existing Tank REAC 3205 is a 2,000 gallon glassed lined tank that will be replaced by exactly similar glassed lined tank; and

   (2)   One (1) Still Tank, identified as # 613 to be installed in building T31 with a capacity of 500 gallons. The existing Still Tank 613 is a 500 gallon stainless steel tank that will be replaced by a 500 gallon Hastelloy tank.

The point source emissions from these process vessels may vent directly to the RTO, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessel to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device.

SO2 and NOx emissions are voluntarily controlled by scrubbers. CO emissions will be voluntarily vented to the RTOs. No emission limits on SO2, NOx, or CO are needed.

History

The source has submitted a Title V permit (TV 157-6879-00006) on October 10, 1996, and it is still pending for issuance.

Recommendation

The staff recommends to the Commissioner that the Significant Source Modification be approved.

This recommendation is based on the following facts and conditions:

Unless otherwise stated, information used in this review was derived from the application and additional information submitted by the applicant.

An application for the purposes of this review was received on May 14, 2002, with additional information received via e-mail on June 11, 2002.

Emission Calculations

(a)   Replacement Tanks Emissions: See Pages 1 through 3 Excel Spreadsheets, and Appendix A for detailed calculations.

Potential To Emit

Pursuant to 326 IAC 2-1.1-1(16), Potential to Emit is defined as "the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or type or amount of material combusted, stored, or processed shall be treated as part of its design if the limitation is enforceable by the U. S. EPA."

This table reflects the PTE before controls. Control equipment is not considered federally enforceable until it has been required in a federally enforceable permit.

Pollutant	Potential To Emit (tons/year)
PM	0.00
PM-10	0.00
SO_2	15.15
VOC	39.11
CO	9.9
NO_x	0.85

Note: For the purpose of determining Title V applicability for particulates,
PM-10, not PM, is the regulated pollutant in consideration.

HAPs	Potential To Emit (tons/year)
Inorganic HAPs Combined	29.71
Organic HAPs Combined	39.11
TOTAL HAPs	68.82

Justification for the Permit Level

These replacement process tanks are subject to 326 IAC 2-7-10.5(d)(6), Minor Source Modification, as they are a "modification that is subject to a reasonably available control technology (RACT), a new source performance standard (NSPS), or a national emission standard for hazardous air pollutants (NESHAP) and the RACT, NSPS, or NESHAP is the most stringent applicable requirement, except for those modifications that would be subject to the provisions of 40 CFR 63, Subpart B Hazardous Air Pollutants: Regulations Governing Constructed or Reconstructed Major Sources*. As part of the application required under subsection (b), the applicant shall acknowledge the requirement to comply with the RACT, NSPS, or NESHAP".

Actual Emissions

The following table shows the actual emissions from the source. This information reflects the 1999 OAQ emission data.

Pollutant	Actual Emissions (tons/year)
PM	0.00
PM-10	408.00
SO_2	1,574
VOC	142.00
CO	188.00
NO_x	401.00

Source Status

Existing Source PSD, Part 70 or FESOP Definition (emissions after controls, based upon AIRS Facility Quick Look Report, updated January 22, 1999).

Pollutant	Emissions (ton/yr)
PM	682.1
PM10	682.1
SO_2	5,626
VOC	5,351
CO	363
NO_x	2,834

(a)   This existing source is a major stationary source because an attainment regulated pollutant is emitted at a rate of 100 tons per year or more, and it is one of the 28 listed source categories.

Potential to Emit of Modification After Issuance

The table below summarizes the potential to emit, reflecting all limits, of the significant emission units after controls. The control equipment is considered federally enforceable only after issuance of this Part 70 source modification.

Process/Facility	Capacity (gallons)	Limited/Controlled Potential to Emit				
		VOC	CO	SO2	NOx	Total HAPs
T29 Process Vessel REAC 3205	2,000	1.45				23.77
	Fugitive	0.097				4.70
T31 Still Tank 613	500	0.74				5.94
	Fugitive	1.16				
TOTAL Controlled Emissions		3.45	9.9	15.15	0.85	5.94
PSD Significant Levels		40	100	40	40	N/A

Note: Tank Total HAPs = tank controlled inorganic emissions + tank controlled organic emissions + fugitive emissions

(a)   T29 Process Vessel REAC 3205 and T31 Still Tank 613 are replacement of the old process

tanks, which qualify as routine maintenance, repair, and replacement under the PSD rules (40 CFR 52.21) and 326 IAC 2-2, and are exempt from the PSD permitting requirements.

County Attainment Status

The source is located in Tippecanoe County.

Pollutant	Status
PM-10	attainment
SO_2	attainment
NO_2	attainment
Ozone	attainment
CO	attainment
Lead	attainment

(a)   Volatile organic compounds (VOC) are precursors for the formation of ozone. Therefore, VOC emissions are considered when evaluating the rule applicability relating to the ozone standards. Tippecanoe County has been designated as attainment or unclassifiable for ozone.

(b)   Tippecanoe County has been classified as attainment or unclassifiable for all the other criteria pollutants. Therefore, these emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2 and 40 CFR 52.21.

Federal Rule Applicability

(a)   New Source Performance Standards (NSPS):
(1)   326 IAC 12, 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for which construction, reconstruction, or modification commenced after July 23, 1994. This NSPS is not applicable to the new replacement tanks, because they are process tanks and not storage tanks.

(2)   326 IAC 12, 40 CFR Part 60, Subpart VV - Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The replacement tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(3)   40 CFR § 60.610, Subpart III - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes -

The replacement tanks are not subject to this NSPS because they are not air oxidation units.

(4)   40 CFR § 60.660, Subpart NNN - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations.

The replacement tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(5)   40 CFR § 60.700, Subpart RRR - Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing

Industry (SOCMI) Reactor Processes.

The replacement tanks are not subject to this NSPS because they are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(6)   There are no other New Source Performance Standards (NSPS)(326 IAC 12 and 40 CFR Part 60) applicable to this source.

(b)   National Emission Standards for Hazardous Air Pollutants (NESHAPs):
(1)   40 CFR Part 63, Subparts I and H - National Emission Standards for Organic Hazardous Air Pollutants for Certain Processes Subject to the Negotiated Regulation for Equipment Leaks; and 40 CFR Part 63, Subpart H - National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks.

The replacement tanks are subject to these NESHAPs, Subpart I and H when Methylene Chloride is used in them for pharmaceutical synthesis operations. Eli Lilly will comply with these requirements, with the implementation of Eli Lilly's LDAR program, when Methylene Chloride is used in the tanks.

(2)   40 CFR Part 63, Subpart GGG - National Emission Standards for Hazardous Air Pollutants for Pharmaceutical Production which was promulgated on September 21, 1998. This NESHAP applies to a new a source for which construction or reconstruction commenced after April 12, 1997 and the standard is applicable at the time of construction or reconstruction; or a pharmaceutical manufacturing process unit (PMPU) dedicated to manufacture a single product that has the potential to emit 10 tons per year of any one HAP or 25 tons per year of combined HAPs for which construction commenced after April 12, 1997 or reconstruction commenced after October 21, 1999.

The replacement tanks does not constitute a construction or reconstruction of a pharmaceutical manufacturing process unit (PMPU) nor does it constitute a construction or reconstruction of an affected facility. Therefore, these tanks will be subject to the standards of Subpart GGG for existing affected source, and will be in compliance no later than the compliance date, October 21, 2002.

Due to time constraint for minor source modification approval, the requirements for this NESHAP will not be detailed in this permit (MSM 157-15636-00006), but instead will be made in the Part 70 permit. The rule has been attached to the permit.

State Rule Applicability - Entire Source

(a)   326 IAC 2-2 (Prevention of Significant Deterioration) and 40 CFR Part 52.21
In Minor Source Modification 157-11949-00006, issued on May 3, 2000, replacements tanks for Lilly were determined to qualify as routine maintenance, repair, and replacement and were not subject to 326 IAC 2-2, and 40 CFR Part 52.21. Subsequent permits issued for replacement tanks used the same justification:

(1)   Nature and extent - Replacement of a pharmaceutical process tank with a like-kind tank does not involve the replacement of numerous major components of the production site;

(2)   Purpose - Tank replacements do not significantly enhance the present efficiency and

capacity of the plant. Tank replacement projects do not substantially extend the useful economic life of a pharmaceutical plant;

(3) Frequency - Tank replacements within a production building occur relatively frequently instead of only once or twice within a building's useful life;

(4) Cost - A tank replacement is not unusually costly, given the cost of manufacturing equipment. The cost of a new replacement tank is only a small fraction of the cost for an entirely new production building.

(b) 326 IAC 5-1 (Visible Emissions Limitations)
Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Exemptions), opacity shall meet the following, unless otherwise stated in this permit:

(1) Opacity shall not exceed an average of forty percent (40%) any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.

(2) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings) as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

State Rule Applicability - Individual Facilities

(a) 326 IAC 8-5-3 (Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing Operations)
(1) 326 IAC 8-5-3 applies to the manufacture of pharmaceutical products by chemical synthesis. This section applies to the proposed replacement tanks; REAC 3205 and Still Tank #613 since each has the potential to emit 15 pounds per day or more. The sections that are applicable to Lilly are (b)(1), (5) and (6).

Section (b)(1) of this rule requires that the VOC emissions coming from these replacement process tanks shall be controlled by condensers or equivalent controls. The approximate control efficiency required by 326 IAC 8-5-3(b)(1) when using acetone, which has the worst volatility is around 90%.

(A) Pursuant to 326 IAC 8-5-3(b)(1) the outlet gas temperature when using condensers to control the VOC emissions from the replacement process tanks shall not exceed the following:

(i) minus twenty-five degrees Celsius (-25E C) when condensing VOC of vapor pressure greater than forty (40) kilo Pascals (five and eight-tenths (5.8) pounds per square inch);

(ii) minus fifteen degrees Celsius (-15EC) when condensing VOC of vapor pressure greater than twenty (20) kilo Pascals (two and nine-tenths (2.9) pounds per square inch);

(iii) zero degrees Celsius (0EC) when condensing VOC of vapor pressure greater than ten (10) kiloPascals (one and five-tenths (1.5)

pounds per square inch);

    (iv)   ten degrees Celsius (10ĔC) when condensing VOC of vapor pressure greater than seven (7) kiloPascals (one (1) pound per square inch); or

    (v)   twenty-five degrees Celsius (25ĔC) when condensing VOC of vapor pressure greater than three and five-tenths (3.5) kilo Pascals (five-tenths (0.5) pound per square inch).

    (B)   The vapor pressures listed above shall be measured at twenty degrees Celsius (20ĔC).

    (C)   If the equivalent controls are used, the VOC emissions must be reduced by at least as much as they would be by using a surface condenser which meets the requirements of clause (A).

Lilly is in compliance with this section of the rule, controlling the VOC emissions using either condensers in series with the Regenerative Thermal Oxidizer (RTO), or using the RTO alone. Lilly typically uses the existing RTO to control point source VOC emission from the tanks. The RTO, which has been demonstrated to achieve VOC removal efficiency in excess of 95%, will meet and exceed the requirement of the rule. If the RTO cannot be used due to safety issues, an alterative control device may be used. An analysis to demonstrate the alternative controls are equivalent controls will be done before they are used. Lilly would like to continue manufacturing operations in the process vessels included in this application using other existing pollution control equipment that complies with 326 IAC 8-5-3.

    (2)   326 IAC 8-5-3(b)(5) requires the owner or operator to install covers on all in process tanks that contain VOC's. Lilly complies with this section by using covers on all in process tanks, these covers are closed unless production sampling, maintenance, or inspection procedures require operator access.

    (3)   326 IAC 8-5-3(b)(6) requires the owner or operator to repair all visible leaks containing VOC. The repair shall be completed the first time the equipment is off line for a period of time long enough to complete the repair.

(b)   326 IAC 8-1-6 (General Reduction Requirements)
This rule is not applicable because the replacement process tanks are subject to 326 IAC 8-5-3.

(c)   326 IAC 8 (Volatile Organic Sources)
There are no other rule in Article 8 that would apply to the proposed replacement process tanks.

(d)   326 IAC 7 (Sulfur Dioxide Emission Limitation)
All facilities with a potential to emit 25 tons per year or 10 tons per hour of sulfur dioxide shall comply with the limitation under this rule.

The sulfur dioxide emissions from the process tanks are not subject to the emissions limitation under this rule, because the limitation are specifically for combustion facilities.

(e)   326 IAC 2-4.1-1 (Toxics Control Rule)
        The proposed replacement process tanks are not subject to 326 IAC 2-4.1 (New Source
        Toxics Control) because they are subject to 40 CFR Part 63 Subparts I, H, and GGG.

Compliance Requirements

Permits issued under 326 IAC 2-7 are required to ensure that sources can demonstrate compliance
with applicable state and federal rules on a more or less continuous basis. All state and federal rules
contain compliance provisions, however, these provisions do not always fulfill the requirement for a
more or less continuous demonstration. When this occurs IDEM, OAQ, in conjunction with the source,
must develop specific conditions to satisfy 326 IAC 2-7-5. As a result, compliance requirements are
divided into two sections: Compliance Determination Requirements and Compliance Monitoring
Requirements.

Compliance Determination Requirements in Section D of the permit are those conditions that are
found more or less directly within state and federal rules and the violation of which serves as grounds
for enforcement action. If these conditions are not sufficient to demonstrate continuous compliance,
they will be supplemented with Compliance Monitoring Requirements, also Section D of the permit.
Unlike Compliance Determination Requirements, failure to meet Compliance Monitoring conditions
would serve as a trigger for corrective actions and not grounds for enforcement action. However, a
violation in relation to a compliance monitoring condition will arise through a source's failure to take
the appropriate corrective actions within a specific time period.

The compliance monitoring requirements applicable to the replacement tanks are as follows:

1.   T29 Process Vessel REAC 3205 and T31 Still Tank 613 compliance monitoring requirements:

       (a)   The owner or operator shall implement the Leak Detection and Repair (LDAR)
               Program proposed by Eli Lilly, most recently approved by the Office of Air Quality, to
               reduce fugitive VOC emissions from processes that use methylene chloride. If it is
               not feasible to either pressure test a group of fugitive sources or monitor a specific
               compound, then a written justification will be required for each source or compound
               exempted from testing. Any necessary adjustments to the procedures shall be
               submitted to the Office of Air Quality for approval prior to implementation.

       (b)   The Permittee shall record the operating temperature of the Regenerative Thermal
               Oxidizers (RTOs) used in conjunction with the tanks at least once per week when the
               tanks are in operation and venting to the atmosphere. The operating temperature for
               the RTOs shall be maintained at a minimum of 1600 °F until a temperature is
               determined during the most recent stack tests, that corresponds to a destruction
               efficiency of 90% of the VOC captured.

       (c)   When the VOC emissions form the proposed replacement process tanks are
               controlled by the condensers, the outlet gas temperature shall be equal to or less
               than that specified by 326 IAC 8-5-3.

       (d)   The RTOs or Condensers shall operate at all times the equipment being controlled
               are in operation.

These monitoring conditions are necessary because the Regenerative Thermal Oxidizers and the condensers must operate properly to ensure compliance with 326 IAC 8-5-3 (Synthesized Pharmaceutical Manufacturing Operations).

(2)   Stack testing for the new replacement process tanks control equipment, to verify if all these new facilities are in compliance with 326 IAC 8-5-3, will be deferred to follow the schedule in the Part 70 permit. The last tests done for the process tanks RTOs was on October 16, 1997.

Conclusion

The operation of the new replacement process tanks shall be subject to the conditions of the attached **Minor Source Modification 157-15636-00006.**

Appendix A
Emissions Calculations

Source Name: Eli Lilly and Company - Tippecanoe Laboratories
Source Location: 1650 Lilly Road, Lafayette, Indiana 47909
County: Tippecanoe
SIC Code: 2834 & 2879
Part 70 Operation Permit No.:   TV157-6879-00006   Issuance Date: Pending
Minor Source Modification No.:   157-15636-00006
Permit Reviewer: Aida De Guzman

Eli Lilly and Company has submitted an application relating to the replacement of the following process tanks:

(a)   Replacement Tanks:
        (1)   One (1) Process Vessel, identified as REAC 3205 to be installed in building T29 with a capacity of 2,000 gallons. The existing Tank REAC 3205 is a 2,000 gallon glassed lined tank that will be replaced by exactly similar glassed lined tank; and

        (2)   One (1) Still Tank, identified as # 613 to be installed in building T31 with a capacity of 500 gallons. The existing Still Tank 613 is a 500 gallon stainless steel tank that will be replaced by a 500 gallon Hastelloy tank.

Eli Lilly and Company (Lilly) is a research based corporation involved in the development, manufacturing and marketing of human and animal health products.

The process vessels can be used in a variety of operations involved in pharmaceutical manufacturing. These operations are mainly batch in nature and include, but are not limited to heating, cooling, distilling (atmospheric and vacuum), extracting, crystallizing, chemical synthesis, cryogenic service, and associated operations.

The point source emissions from these process vessels may vent directly to the RTO, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessel to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device.

The process used to model the emissions from the process vessels is a worst case process designed to give a maximum emissions estimate for any process that may be run in this piece of equipment. While process vessels are only used in the production of bulk pharmaceutical drugs, the type of products manufactured will vary with the market demand.

The emission calculations assume the control device is a condenser with exit gas temperature of -15^0C. The VOC emissions leaving the condensers are calculated assuming ideal liquid and vapor equilibrium at a given temperature and pressure. The condenser is used in the calculations since it provides the level of emission control that would be required to comply with 326 IAC 8-5-3. This demonstrates that the control efficiency required to comply with 326 IAC 8-5-3 is approximately 90 percent. When condensers are used to control VOC emissions, these condensers will achieve an efficiency of 90%. The actual VOC control device normally used on the tank will be either an existing condenser in series with the existing RTO, or the RTO alone. The RTO alone has demonstrated to achieve in excess of 95% VOC reduction and therefore meets the and exceeds the requirements of 326 IAC 8-5-3. Lilly would like to maintain the flexibility to use condensers during the RTO malfunction.

Emissions calculations for point source VOC emissions from the tanks were performed by the applicant, using the equations found in the EPA guideline for control of volatile organic compounds emissions from manufacture of synthesized pharmaceutical products, EPA-450/2-

78-029. To estimate the maximum potential uncontrolled and allowable VOC emissions for each piece of equipment, acetone was used as solvent in the emission calculations and 8760 hours/year operating schedule was assumed to get a worst case potential emissions scenario. For all processes, acetone although a non-photochemically reactive hydrocarbon, was used in the calculations because it has the highest volatility among the solvent utilized. Since solvents with vapor pressures as high as that of acetone are not always used in the processes, the assumption used in the calculations will generate a worst case estimate for the potential VOC emissions.

The various assumptions used in calculating emissions from different process activities may be found with the relevant equations in the sample calculations. For this application, the process tank VOC emission estimates are based on a combination of the typical unit operations that are done to perform a process. The steps in the model process include charging, heating, tank evacuation with vacuum distillations, and atmospheric distillations. For example, a distillation process can include a tank evacuation, a heating step, and a distillation step.

The fugitive VOC emissions estimate is based on a fugitive source count for each of the respective process vessels. Potential fugitive emissions were estimated by multiplying the SOCMI factors for fugitive emission sources by the number of each type of source. The source count does not include any existing piping or fugitive sources that are not associated with the process vessels. The duration of exposure is assumed to be 24 hours/day, 7 days per week, and 52 weeks per year.

SO2, Nox, and CO emissions may also be emitted from Still Tank 613 in T31. There may be processes run where these pollutants are emitted from a gas evolving process step. Three different reactions were chosen to obtain an estimate of the SO2, Nox, and CO emissions. Each reaction is the highest known emitter of the respective pollutant it emits. There are many fewer processes that emits SO2, Nox, and CO than VOCs, therefore 100 lots/yr were used in the worst case potential emission calculation. This maximum emission rate is much higher that any one tank will emit by itself, but because it is difficult to estimate how much of the emissions can be attributed to each individual tank, the entire building emission is assumed to come from each tank by itself. When summing the total emissions, this factor is taken into account by looking at the maximum emitting tank for each of the buildings.

SO2 and Nox emissions are voluntarily controlled by scrubbers. CO emissions will be voluntarily vented to the RTOs. No emission limits on SO2, NOx, or CO are needed.

LILLY VENT EMISSION PROGRAM FOR POINT SOURCES:

(a)   Applicability of Calculation: The program is used to calculate point source VOC emissions from batch processes.

(b)   Source or Basis of Calculation: The basis for the program are the equations found in EPA's Control Techniques Guideline for Synthetic Pharmaceutical Manufacturing (450/2-78-028, 1978, Appendix B).

(c)   Process Vessel Calculation Assumption:

(1)   Pure acetone is used in all calculations.

(2)   The vessel contains perfectly mixed ideal liquid and vapor phases, and they are continuously in phase equilibrium.

(3)   The vapor leaving the vessel is assumed to have the same composition as the vapor in the tank's vapor space.

(4)   The streams leaving the condensers, where used, are calculated assuming ideal liquid and vapor in equilibrium at the given temperature and pressure.

(5)   The amount of liquid being vaporized in the tank is assumed to be small compared to the total liquid volume. Therefore, the liquid composition and the volume of the vapor space can be assumed to be constant.

(6)   The control device is a condenser that will produce an exit gas temperature of -15^{0}C (per 326 IAC 8-5-3 for acetone)under all loading, or an equivalent control device that will have the same control efficiency as this condenser.

(7)   VOC emissions are from the tanks themselves, not ancillary existing equipment.

(8)   Nitrogen purge rate for inerting purposes is 5 scfh.

(9)   Charging into a tank is at 60 gallons per minute.

(10)   Tanks are charged 2/3 full of acetone for all tank sizes.

(11)   The tank is assumed to start each operation 2/3 full, except for "charging" where the tank is empty at the start. The vapor space is assumed to be composed of gaseous N_2 in equilibrium with acetone vapor at the stated temperature.

(12)   The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over ½ of the liquid volume. In the 4,000 gallon tank case, however, only 1/3 of the liquid is distilled. The time required to distill more solvent would push the Possible Process Chain's time over 24 hours.

(13)   During the atmospheric distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 23^{0}C (55^{0}F cooling water = 12.78^{0}C + 10^{0}C approach = 22.78 ~ 23^{0}C). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of -15^{0}C, or a control device with the same control efficiency. The emissions from this condenser are listed in the potential controlled column.

(14)   There is a 5 scfh nitrogen purge during all atmospheric distillations.

(15)   "Evacuation" means evacuating the tank from atmospheric pressure down to 1 mmHg above the vapor pressure of acetone at 20^{0}C.

(16)   The Vacuum Distillation inert leak rate is 0.5 scfm for all tank sizes and vacuum levels. This is the average leak rate.

(17)   The Vacuum Distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at 20^{0}C, then distilling over ½ of the liquid volume.

(18)   During the Vacuum Distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 0^{0}C (-10^{0}C brine + 10^{0}C approach = 0^{0}C). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of -15^{0}C, or a control device with the same control efficiency. The emissions from this condenser are listed in the allowable column.

(19)   The Pressure Transfer operation consists of pressuring-up the tank with nitrogen from 1 to 2 atmospheres to force the liquid out of the tank. When the tank is empty, this pressure is released from the tank.

(20)   There are no process condensers on the purge, charge, heat from 20^{0}C to 55^{0}C,

evacuation, or de-pressurization steps. A condenser is not needed to perform these operations.

(21)   It is assumed that during the time the tank is not performing a set of steps that it can be doing another operation that the 24 hour sweep will account for that operation's emissions, i.e., stirring, cooling.

(22)   "Per Step" emissions are for performing the given step, or series of steps, once.

(23)   "Yearly" emissions are for performing the given step, or series of steps, once per day, 365 days per year.

(24)   Efficiencies are calculated according to the following formula:

Efficiency = $\underline{100\% \text{ Potential Uncontrolled Emissions } - \text{ After Controlled Emissions}}$
 Potential Uncontrolled Emissions

CALCULATIONS NOMENCLATURE

a,b,c	-	Antoine coefficients
i	-	The i th component
K_{ideal}	-	Vapor/liquid equilibrium constant
LMPD	-	Log mean pressure difference (mm Hg)
L	-	Total moles in liquid phase (lb-mole)
L_i	-	Moles of component i in liquid phase (lb-mole)
M	-	Mass(lb)
Mi	-	Mass of component i (lb)
m	-	Mass rate (lb/hr)
m_i	-	Mass rate of component i (lb/hr)
MW	-	Molecular weight (lb/lb-mole)
MW_i	-	Molecular weight of component i (lb/lb-mole)
N or V	-	Total moles in vapor phase (lb-mole)
n	-	Molar rate (lb-mole/hr)
N_i or V_i	-	Moles of component i in vapor phase (lb-mole)
n_i	-	Molar rate of component i (lb-mole/hr)
P or P_{total}	-	Total Pressure (mm Hg)
P_i	-	Partial pressure of component i (mm Hg)
p^0	-	Vapor pressure (mm Hg)
p_i^0	-	Vapor pressure of component i (mm Hg)
R	-	Ideal Gas Constant (10.73 ft^3 psia/lb-mole ^0R)
T	-	Temperature in Kelvin (K) or Rankine(R)
t	-	Temperature in Celsius (C) or Fahrenheit (F)
V	-	Volume (ft^3)
V or N	-	Total moles in vapor phase (lb-mole)
V_i or N_i	-	Moles of component i in vapor phase (lb-mole)
v	-	Volumetric rate (gpm for liquid, cfm for vapor or gas)
x_i	-	Liquid mole fraction of component i
y_i	-	Vapor mole fraction of component i
Z	-	Total moles entering condenser (lb-mole)
Z_i	-	Total moles of component i entering condenser (lb-mole)

CALCULATION THEORY/SAMPLE CALCULATIONS:

Note: All VOC emissions were calculated using Eli Lilly and Company's Vent Emission Program. The following sample calculations use the same equations as those in the program, The sample calculation results, however, may differ slightly due to rounding of significant digits.

Physical Properties:

Acetone:

Molecular weight = 58.08

Antoine Coefficients (-59.4^0C to 56.5^0C)

a = 16.82

b = 2993

c = -35.63

Specific gravity @ 20^0C = 0.792

Nitrogen(gaseous):

Molecular weight = 28

Possible Operation Step A: N_2 inerting purge @ 5 scfh:

Tanks that contain a flammable liquid(s) or a VOC(s) are purged with gaseous N_2 to keep the vapor space above the liquid inert. As a continuous stream of N_2 flows into the tank, N_2 becomes saturated with vapor that is in equilibrium with the liquid. An emission is created as this N_2/vapor mixture leaves the tank.

Liquid temperature	=	293.15^0 K (20^0C)
Vessel Pressure	=	760 mm Hg

Pure acetone is in the tank during this step, so the mole fraction of liquid component (x_A) is 1.

Potential uncontrolled VOC emissions:

Vapor pressure calculation: Using the Antoine Equation at liquid temperature (20^0C),

$\ln(PA^0$ (mmHg))	=	$[a-(b/(T(^0K)+c))]$
PA^0 mmHg	=	exp $[a-(b/(T(^0K) + c))]$
	=	exp [16.82 - (2993/(293.15 - 35.63))]
	=	180.84 mmHg

Equilibrium Concentration: Raoult's Law states that the partial pressure of acetone, PA, can be calculated by multiplying the vapor pressure, PA^0 , by the liquid mole fraction, xA, which equals the total pressure, P, multiplied by the vapor mole fraction, yA.

(P)(yA)	=	$(PA^0)(x_A)$	= PA

Rearranging yields:

yA/xA	=	$PA^0/P = K_{ideal}$
yA	=	$(K_{ideal})(xA)$
	=	(180.84/760)(1)
	=	0.2379

Inert Sweep Rate: It is assumed that the amount of N_2 entering the tank leaves the tank at the same rate. It is assumed that the N_2 stream enters the tank at 70^0F (530^0R) and 14.72 psia. Using the ideal gas law;

PV	=	nRT	
PV	=	(m/MW)RT	Since: n = m/MW
m	=	PV(MW)/RT	

The mass flow rate, m, is:

mN_2 (lb/hr)	=	$\{v(cfh)(MWN_2)(14.72 \text{ psia})\}/(R)(530^0R)$
	=	$\{(5 \text{ scfh})(28)(14.72 \text{ psia})\}/(10.73)(530^0R)$
	=	0.3624 lb/hr
For 24 hours:		
M_{N2} (lb)	=	(0.3624 lb/hr)(24 hrs)
	=	8.70 lb

Mass of acetone leaving the system: The number of moles of volatile components leaving the

tank is related to the number of moles leaving the system and the partial pressure of the volatile and inert compounds. For a one component system:

$$(P_A)(v) = (nA)(R)(T)$$

For the inert sweep, v, R, and T are assumed constant. Therefore, the ratio of moles of inert to volatile compounds can be calculated as:

PA/P_{N2} $= nA/n_{N2}$ Since: $n_{N2} = m_{N2}/MW_{N2}$
$= (n_A)(MW_{N2})/m_{N2})$
$= (m_A)(MW_{N2})(m_{N2})(MW_A)$ Since: $n_A = m_A/MW_A$
$P_A/(P-P_A) = (m_A)(MW_{N2})/(m_{N2})(MW_A)$ Since: $P_{N2} = P-PA$

The mass rate of acetone vapor emitted by the N_2 sweep is:

mA(lb/hr) $= (m_{N2}/MW_{N2})(MW_A)(P_A/(P_A-P))$
$= (0.3624/28)(58.08)(180.84/(760-180.84))$
$= 0.2347$ lb/hr

For 24 hours:

MA (lb/day) $= (0.2347$ lb/hr$)(24$ hrs$)$
$= 5.63$ lb/day

This compares to 5.73 lb as calculated by the Emission Calculation Program.

Allowable
Allowable VOC emissions are based on the emission control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15^0 C, to ensure compliance with 326 IAC 8-5-3 for acetone.

Vapor pressure calculation: Using the Antoine Equation at -15^0C,
ln (PA(mmHg)) $= [a-(b/(T(^0K)+c))]$
PA(mmHg) $= \exp [a-(b/(T(^0K) + c))]$
$= \exp [16.82 - (2993/(258.15 - 35.63))]$
$= 29.06$ mmHg

K_{ideal} $= 29.06/760 = 0.0382$

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser:

Z $= V + L$

Likewise for each component:
Z_i $= V_i + L_i$ Where $L_i = 0$ for inert
or Z_i $= (V)(y_i) + (L)(x_i)$ for volatile compounds
Z_i $= (V)(y_i)$ for inert compounds
Z_i $= (V)(K_{ideal})(x_i) + (L)(x_i)$ Since $K_{ideal} = y_i/x_i$
Z_i/L $= (V/L)(K_{ideal})(x_i) + (x_i)$
Z_i/L $= [(V/L)(K_{ideal}) + 1](x_i)$
$Z_i/[(V/L)(K_{ideal}) + 1]$ $= (L)(x_i) = L_i$
L_i $= Z_i/[(V/L)(K_{ideal}) + 1]$

To solve the mass balance for the number of moles in the liquid and vapor phases:
(1) Assume a V/L ratio(where V is total molar volume including the inert gases)
(2) Calculate the liquid moles of each volatile component by:
L_i $= Z_i/[(V/L)(K_{ideal}) + 1]$

(3)   Calculate the vapor moles of each volatile component by:
       V_i = $Z_i - L_i$
(4)   The moles of inert out of the condenser is equal to the moles into the condenser, which
       has been calculated previously.
(5)   Sum the volatile component liquid moles (L) and the volatile and inert component vapor
       moles (V) and compute the ratio V/L.
(6)   The computed V/L is compared to the assumed V/L. If they are not equal, a new
       iteration is performed using the calculated V/L.

       The following table shows the values used for the iteration:

Iteration	Assumed V/L	Calculated		V_{N2}	Calculated V/L
		LA	VA		
1	0.50	0.0952	0.0018	0.3106	3.28
2	3.28	0.0862	0.0108	0.3106	3.73
3	3.73	0.0849	0.0121	0.3106	3.80
4	3.80	0.0847	0.0123	0.3106	3.81
5	3.81	0.0847	00.0123	0.3106	3.81

The mass of each component is related to its moles by:
M_i(lbs)   = $(V_i)(MW_i)$
M_A(lbs)   = $(0.0123)(58.08)$
                                         =   0.71 lb

Possible operation Step B: Charge 2000 gallon tank 2/3 full:
This calculation models the emissions associated with the displacement of vapor from a tank
that is being filled with a VOC. The tank in this case is filled 2/3 full with acetone at 20 ^{0}C at 60
gallons per minute. The tank is assumed to be filled with gaseous N_2 before charging, and the
displaced vapor is N_2, 100 % saturated with acetone.

Liquid temperature   = 293.15^0K (20 ^{0}C)
Tank pressure   =   760 mmHg

Pure acetone is charged into the tank during this step, so the mole fraction of liquid component
(x_A) is 1.

Potential VOC emissions:
Volume of charged material:
V_L =   (2000 gallons)(2/3)   = 1333.33 gallons
                                =   (2000 gal)(1ft^3/7.4805 gal)(2/3) = 178.24 ft^3

This is also equal to the volume of inert being displaced.

Molar displacement rate of inerts:
The volatile and inert vapor partial pressures are related by:
P_{Total} = $P_A + P_{N2}$

The partial pressure of N_2 is then:
P_{N2} = $P_{Total} - P_A$
                                =   (760)- (180.84)
                                =   579.16 mmHg

	=	(579.16 mmHg)(14.696 psia/760 mmHg)
	=	11.20 psia

Applying Dalton's Law:

nN2	=	$(PN2)(V_L)/[(R)(T)]$
	=	$(11.20\ psia)(178.24\ ft^3)/((10.73)(527.67))$
	=	0.3526 lbmoles

Mass of Acetone leaving the tank:

The mass rate of acetone vapor emitted by the liquid displacement:

$M_A(lb)$	=	$(M_{N2})(MW_A)(P_A/P_{N2})$
	=	(0.3526)(58.08)(180.84)/(579.16)
	=	6.39 lbs

This compares to 6.39 ls as calculated by the Emission Calculation Program.

Allowable

Allowable VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces as exit vapor temperature of -15 ^{0}C.

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's Potential Controlled calculation method.

The resulting VA of the iterative calculation is: 0.0140

The mass of each component is related to its moles by:

Mi (lbs)	=	(Vi)(MWi)
MA (lbs)	=	(0.0140)(58.08)
	=	0.81 lb

This compares to 0.81 lb as calculated by the Emission Calculation Program.

Possible operation Step C: Heat tank contents from 20 ^{0}C to 55 ^{0}C:

This calculation models the emissions associated with the displacement of vapor from acetonethat is being heated from 20 ^{0}C to 55 ^{0}C. The vapor space above the liquid is assumed to consist of gaseous N_2 saturated with acetone vapor. As the liquid heats up, it vaporizes and displaces the vapor above it, causing an emission from the tank.

Initial liquid temperature	=	293.15^{0}K (20 ^{0}C, 527.67 ^{0}R)
Final liquid temperature	=	328.15 ^{0}K (55 ^{0}C, 626.67 ^{0}R)
Tank pressure	=	760 mmHg

Volume of acetone in tank:

V_L	=	(2000 gallons)(2/3) = 1333.33 gallons
	=	(1333.3 gallons)(1 ft^3/7.4805 gal)(2/3) = 178.24 ft^3

Volume of vapor space:

V_{VS}	=	(2000 gallons)(1/3) = 666.67 gallons
	=	(666.67 gallons)(1 ft^3/7.4805 gal)(1/3) = 89.12 ft^3

Pure acetone is in the tank during this step, so the mole fraction of liquid component (xA)is 1.

Potential Uncontrolled:
Vapor Pressures: Initial and final vapor pressures are calculated using the Antoine equations as previously shown.

Initial:
Acetone, $P^0_{A,I}$ = 180.84 mmHg (3.50 psia)   K Ideal,I = 0.2379
Nitrogen, $P^0_{N_2,I}$ = 579.16 mmHg (11.20 psia)

Final:
Acetone, $P^0_{A,F}$ = 726.49 mmHg (14.05 psia) $K_{Ideal,F}$ = 0.9559
Nitrogen, $P^0_{N_2,F}$ = 33.51 mmHg (0.65 psia)

Change in moles of inert in vapor space between initial and final conditions:

$N_{N2,I} - N_{N2,F}$ = $[((P_{N2,I})/(T_I)) - ((P_{N2,F})/(T_F))](V_{VS})/(R)$
= $[((11.20)/(527.67))-((0.65)/(626.67))](89.12)/(10.73)$
= 0.1677 lbmoles

Amount of acetone being displaced from the tank:
The total number of moles in the vapor space and the vapor phase composition are both functions of temperature. Since the molar rate at which vapors leave the tank is greatly influenced by the components partial pressure, it is assumed that for any component:

$N_i / (LMPD)_i$ = Constant

Where N_i is the number of moles of component i having left the tank, and the Log Mean Pressure Difference of i, $(LMPD)_i$, is calculated as follows:

$(LMPD)_i$ = $(P_I - P_F)_i / \ln(P_I/P_F)_i$
$(LMPD)_A$ = $(180.84 - 726.49)_A / \ln(180.84/726.49)_A$
= 392.38

$LMPD)_{N2}$ = $(579.16 - 33.51)_{N2} / \ln(579.16/33.15)_{N2}$
= 190.75

Therefore, the number of moles of inerts leaving the vessel and the LMPD of the inert and the volatile components, the number of moles of acetone can be estimated by:

N_A = $(N_{N2})(LMPD)_A /(LMPD)_{N2}$

And the mass of acetone leaving the tank is:

M_A (lbs) = $(N_{N2})[(LMPD)_A /(LMPD)_{N2}](MW_A)$
= $(0.1677)[(392.38)/(190.75)](58.08)$
= 20.04 lb

This compares to 19.89 lb as calculated by the Emissions Calculation Program.

Allowable
Allowable VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of $-15\,^0C$

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's Allowable calculation method.

The resulting V_A of the iterative calculation is: 0.0067

The mass of each component is related to its moles by:
M_i (lbs) = $(V_i)(MW_i)$
M_A (lbs) = $(0.0067)(58.08)$

$$= \quad 0.39 \text{ lbs}$$

This compares to 0.39 lb as calculated by the Emission Calculation Program.

Possible Operation Step D: Atmospheric Distillation

The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over 2 of the liquid volume. During the atmospheric distillations, there are two condensers. The first is a process control condenser that produces an exit gas temperature of $23\ ^0C$ ($55\ ^0F$ cooling water = $12.78\ ^0C$ + 10^0C approach = $22.78^0C \sim 23^0C$). The second is an emission control condenser that produces an exit gas temperature of -15^0C, or a control device with the same control efficiency.

Heating acetone to its boiling point is modeled using the method outlined in Step C. The distillation is modeled using the method outlined in Step A with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

Possible Operation Steps E & F: Vacuum Distillation

The Vacuum distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at 20^0C , then distilling over 2 of the liquid volume. Because the system is under vacuum, and it is not perfectly sealed, air leaks into the system. During the vacuum distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of $0\ ^0C$ ($-10\ ^0C$ brine + 10^0C approach = 0^0C). The second is an emission control condenser that produces an exit gas temperature of -15^0C, or a control device with the same control efficiency.

Evacuating the tank to acetone's boiling point (at 20^0C) is modeled using the method outlined below. The air leakage during the distillation is modeled using the method outlined in Step A with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

Liquid temperature	=	293.15 K (20^0C, 527.67^0R)
Initial tank pressure	=	760 mmHg

Volume of acetone in tank:

V_L	=	(2000 gallons)(2/3) = 1,333.33 gallons
	=	(2000 gallons)(1 ft^3/7.4805 gallons)(2/3) = 178.24 ft^3

Volume of vapor space:

V_{VS}	=	(2000 gallons)(1/3) = 666.67 gallons
	=	(2000 gallons)(1 ft^3/7.4805 gallons)(1/3) = 89.12 ft^3

Pure acetone is in the tank during this step, so the mole fraction of liquid component (X_A) is 1.

Potential Uncontrolled:

Vapor Pressures: Calculated using the Antoine equations as previously shown.
Initial:

Acetone, $P\ ^0A,I$	=	180.84 mmHg $K_{ideal,A}$ = 0.2379
Nitrogen, $P\ ^0N_2,I$	=	579.16 mmHg

Mass of N_2 evacuated from tank: Since the vapor pressures of acetone and N_2 are constant, as well as the vapor space and temperature, the moles of acetone also remain constant, i.e., as any acetone vapor leaves the system, it is replaced by an equal amount from the liquid phases. The decrease in pressure, therefore, is due to the evacuation of N_2. The number of moles of N_2 leaving the system are calculated by:

($N_{N2,Initial}$ - $N_{N2,Final}$)	=	$(P_{Initial} - P_{Final})(V_{VS})/[(R)(T)]$
	=	((14.696 - 3.5)(89.12)/(10.73)(527.67)
	=	0.1762 lbmoles

Mass of Volatiles evacuated from tank: Using the LMPD method as described in Step C (Heat tank contents from 20^0C to 55^0C) the mass of acetone leaving the tank is calculated by:

$$(LMPD)_{N2} = (P_I - P_F)_{N2} / \ln(P_I/P_F)_{N2}$$
$$= (579.16 - 0.16) / \ln (579.16/0.16)$$
$$= 70.66$$

$$M_A \text{ (lbs)} = [(N_{N2})/(LMPD)_{N2}](MW_A)(P_A)$$
$$= [(0.1762)/(70.66)](58.08)(180.84)$$
$$= 26.19 \text{ lb}$$

This compares to 26.15 lb as calculated by the Emission Calculation Program.

Allowable
Allowable VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15^0C.

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is similar to Step A's potential controlled calculation method.

The resulting V_A of the iterative calculation is: 0.0337

The mass of each component is related to its moles by:

$$M_i \text{(lbs)} = (V_i)(MW_i)$$
$$M_A \text{(lbs)} = (0.0337)(58.08)$$
$$= 1.96 \text{ lb}$$

This compares to 1.96 lb as calculated by the Emissions Calculation Program.

General Organic Synthesis Process Description for STILL TANKS

(a)   Charge 1350L of solvent (**1A**) into STILL 1, cool down to 0^0C (**1B:** sweep -25^0C) (**1E:** sweep 0^0C). While cooling, charge 135 kg of solid #1. STILL 1 is vented to scrubber during this time. Estimated time - 3 hours.

(b)   Position a Portable Tank for the addition of 159 kg of liquid #1 to STILL 1. Vent Portable Tank to scrubber. Estimated time - 3 hours.

(c)   With temperature of STILL 1 maintained at 10-15^0C, liquid # 1 is added (**3A**) at a controlled rate. Estimated time - 1.5 hours (**3B:** sweep) (**3C**: Blow lines)

(d)   The reaction mixture in STILL 1 is heated to boiling (**4A**) and held under total reflux for one hour. If required, this can be done under vacuum. Estimated time - 2.5 hours. (**4B**: sweep during heating) (**4C**:sweep during reflux)

(e)   Solvent is distilled off under atmospheric pressure and is collected in Receiver 1 (**5A**). The distillation is carried out until the desired volume of residue (750 L) is achieved. Receiver 1 is vented to the scrubber during the distillation with the jacket maintained at 4^0C. Estimated time - 4 hours. (**5B**: sweep)

(f)   After the distillation, maintain Receiver 1 at 30^0C while adding 1125 L of purified water (**6B**) and 150 kg of solid 32 (**6C**). Pressure transfer (**6D**: depress) to the aqueous waste tank (**6E**). Estimated time - 2 hours.

(g)   Cool STILL 1 to 5-10^0C. Estimated time - 1 hour (**7A**: sweep 56-10^0C).

(h)   Charge 950 L of purified water to STILL 2. Cool to 10^0C and charge 162 kg solid #3.

Estimated time - 4 hours.

(i)   The solvent solution is pressure transferred (**9B**: Depress) from STILL 1 to the solution in STILL 2 (**9A**) and temperature is maintained between 0 and 10^0C. Warming (**9C**) is done slowly, watching for foaming, to $25\,^0$C and agitation continued for 30 minutes. STILL 2 should be vented to the scrubber at this time. Estimated time - 14 hours (**9D**: Sweep) (**9E**: Blowlines).

(j)   The solvent and water is distilled off (**10A, 10B**) to Receiver 2 (**10C**) at temperature of 100 to $102\,^0$C. Receiver 2 is vented to scrubber when gassing subsides. Estimated time - 10 hours (**10D**: Sweep).

(k)   Distillate from Receiver 2 is pressure transferred (**11A**: Depress) to waste tank (**11B**). Estimated time - 0.5 hour

(l)   The aqueous residue in STILL 2 is cooled to $20\,^0$C. STILL 2 is vented to scrubber. Estimate time - 2.5 hours.

(m)   STILL 1 is charged with 1000 L solvent (**13A**-S1) and 56.8 kg solid #4 (**13B**-S1). Slurry is pressure (**13D**-S1) transferred to aqueous residue (**13C**-S2)(in STILL 2) maintaining $20\text{-}25^0$C. STILL 1 (**13E**-S1) is rinsed with approximately 75 L solvent. Rinse is pressure (**13G**-S1) transferred to STILL 2 (**13F**-S2). Estimated time - 1.5 hours (**13G**: Sweep S1-1.5 hrs) (**13I**: S2-1 hr) (13K; Blowlines - S2).

(n)   Receiver 1 is charged with 113.5 kg (**14A**) of liquid #2. Slight nitrogen pressure is maintained on Receiver 1. Estimated time - 1 hour

(o)   Liquid #2 (**15A**) is added to STILL 2 over 1 hour maintaining $20\text{-}25\,^0$C. Receiver 1 is rinsed (**15C**) with about 50 kg solvent and transferred to STILL 2 (**15D**). To this mixture 250L (**15F**) purified water is added. Estimated time - 2.5 hours (**15B**: Depress - R1, **15E**: Depress - R1, **15G**: Blowlines - S2).

(p)   Reaction mixture is pressure transferred (**16C**) from STILL 2 to a filter press. Filtrate is collected in Receiver 2 (**16A**). Wetcake is washed with solvent (**16D, 16E, 16F** Depress). The wetcake is transferred to drums for treatment. Filtrate is pumped from Receiver 2 to STILL 2. STILL 2 having been rinsed with solvent. Estimated time - 6 hours (**16B**: Sweep).

(q)   Filtrate and wash are allowed to settle for 30 minutes at $20\text{-}25^0$C. Lower solvent layer is separated (pressure or pump) (**17C**) into Receiver 1 (**17B**). Estimated time - 1 hour (**17A**: Sweep-R2, **17D**: Sweep-R1, **17E**: Blowlines).

(r)   To the aqueous layer in Receiver 2 (**18A**) is added 75 L solvent and stirred for 15 minutes at temperature $20\text{-}25^0$C. Layers are allowed to settle for 30 minutes and the lower layer solvent is separated to Receiver 1 (**18C**) containing previous solvent layer. Estimated time - 1.5 hours (**18B**: Sweep-R2, **18D**:Depress, **18E**: Sweep-R1, **18F**: Blowlines).

(s)   Sample of aqueous layer in Receiver 2 is taken, pH is adjusted to 7 or above. Aqueous waste is pressure transferred to waste tank for treatment. Estimated time - 1 hour.

(t)   Receiver 2 is rinsed with 175 L solvent (**20A**)which is then pressure transferred (**20B**) to waste tank (**20C**). Estimated time - 0.5 hour (**20D**: Sweep-R2).

(u)   A small amount of water may separate from the combined solvent layers in Receiver 1. Layers should settle for a minimum of 1 hour. The lower solvent layer is separated and pumped from Receiver 1 to STILL 2 (**21A**). The upper aqueous is pressure transferred to a waste tank (**21B**: Sweep-R1, **21C**: Sweep-S2, **21D**: Blowlines) for treatment. Estimated time - 2 hours.

(v)   Solvent is vacuum distilled from STILL 2 (**22A, 22B**) to a solid residue. Maximum jacket temperature should be 80^0C. Distillate is collected in Receiver 2. Temperature at start of distillation is about 20^0C and at completion of distillation is about 24^0C. At the end of distillation the jacket temperature is set to 100^0C and distillate stops at about 60^0C. Estimated time - 10 hours

(w)   Vacuum is broken with nitrogen to atmospheric pressure. Jacket temperature of STILL 2 is adjusted to 50^0C. Estimated time - 1 hour.

(x)   Distillate is treated in Receiver 2 and pressure (**24B**) transferred to a waste carrier (**24A**). Estimated time - 1.5 hour (**24C**:Sweep).

(y)   1200 L solvent is added to residue in STILL 2 (**25A**) and reactor contents are agitated to dissolve all solids. When solids are dissolved, sample is taken and analyzed for water content. Estimated time - 2 hours (**25B**).

(z)   STILL 1 is charged with 75 L solvent (**26A**). Estimated time - 0.25 hour (**26B**: Sweep).

(aa)   STILL 1 is warmed to distill (**27A**) about 25 kg to Receiver 1 (**27B**). STILL 1 is cooled to 25-30^0C and its contents pressure transferred to a solvent recovery (**27C, 27D**). Estimated time - 3 hours (**27E, 27F**: Sweep).

(bb)   To a dry STILL 1, 250 L solvent is added (**28A**), sample taken, and adjusted to 15-20^0C. Then 37.5 kg solids #5 in oil (**28B**) is added from a Portable Tank. STILL 1 is vented to Receiver 1. Estimated time - 1.5 hours (**28C**: Sweep)).

(cc)   Maintaining temperature 28-32^0C, product solution from STILL 2 is pumped to STILL 1 (**29A**). After about 5 minutes addition time, the STILL 1 vent is closed, addition stopped nitrogen purge turned off and reactor is watched for pressure build-up. If pressure build-up occurs, open vent, turn on nitrogen purge and addition continues. If not, continue with transfer. Estimated time - 6.5 hours (**29B**: Sweep).

(dd)   STILL 2 and lines are rinsed with 75 L solvent (**30A**)(pressure (**30D**) transfer to STILL 1 (**30B**)). Estimated time - 0.5 hour. (**30C**: Blowlines)

(ee)   The mixture in STILL 1 is agitated at 30^0C for 1 hour with the vent closed. Pressure is closely monitored. Estimated time - 1 hour.

(ff)   161.25 kg liquid #3 is charged to the Portable Tank from a drum. Nitrogen pressure of 860 mmHg is maintained on the Drop Tank. Estimated time - 1.hour.

(gg)   Liquid #3 is pressure transferred from Portable Tank to STILL 1 (**33A**), while maintaining a temperature of 5-10^0C. Estimated time - 2 hours.

(hh)   Portable Tank (**34A**)and lines are rinsed to STILL 1(**34B**) with approximately 50L solvent (pressure transfer (**34D**) and blow lines (**34C**)). STILL 1 is cooled to - 60^0C. Estimated time - 3 hours (**34E**: Sweep-S1).

(ii)   When the contents of STILL 1 reaches - 60^{0}C, pass ozone through solution (**35A**) maintaining -45^{0}C for24-28 hours. Maintain temperature as cold as possible with jacket set point fixed at -85^{0}C. Shutdown ozone generator when 0.5% ozone leaves STILL 1. Allow air to flow through till 0.01% ozone is reached. Estimated time - 25 to hours. STILL 1 is vented to the scrubber (**35B**: Sweep).

(jj)   STILL 1 contents are agitated at 0^{0}C for 2 hours (**36A**). STILL 1 is set for distillation to Receiver 1 (**36B, 36C, 36I**). The batch is concentrated at 30-35^{0}C until STILL residue weight is 562.5 kg. STILL and Receiver are vented to atmospheric pressure with nitrogen. Final residue is cooled to 5^{0}C (**36D**). The distillate (solvent and water) in Receiver 1 is adjusted to pH greater than 7 with 50% caustic soda solution (**36E, 36F**) and pressure (**36G**) transferred to the aqueous waste tank (**36H**). Estimated time - 13 hours.

(kk)   Receiver is charged with 625 L purified water (**37A**) and cooled to 0-5^{0}C. Maintaining temperature below 20^{0}C, 112.5 kg caustic soda (50% solution) is added. Batch is cooled to 0-5^{0}C and pressure transferred to STILL 1. STILL 1 is maintained at 5-10^{0}C. Estimated time - 5 hours

(ll)   STILL 1 is agitated to 15 minutes then 347.25 kg of solvent is added to STILL 1 (**38A**) and agitated for 10 minutes. The temperature is held at 5-10^{0}C. Agitation is stopped and layers allowed to settle over the next 15 to 20 minutes. Estimated time - 1.5 hours (**38B**: Sweep).

(mm)   The lower aqueous layer (product) is pumped to STILL 2 (**39A**) keeping the emulsion with the upper solvent layer. Estimated time - 0.5 hour (**39B**: Sweep-S1).

(nn)   Solvent layer is treated in STILL 1 (**40B**) and then transferred to the organic waste (**40C**) tank for treatment. Estimated time - 0.5 hour (**40A**:Sweep)

(oo)   963 L of solvent is added to the aqueous layer in STILL 2 (**41A**), agitated for 5 minutes at 5-10^{0}C and pH is checked by taking samples. If pH is greater than 3.1, a small amount of acid is added to bring pH to 2.9 to 3.1. Layers are allowed to settle for 15 minutes. The lower layer is transferred to RECEIVER 1 (**41B, 41C**), keeping the emulsion with the upper aqueous layer. Estimated time - 3 hours (**41D**:Sweep).

(pp)   438 L of solvent is added to the aqueous layer in STILL 2 (**42A**), agitated for 0.5 minute at 5-10^{0}C and pH is checked by taking sample. If pH is greater that 3.1, a small amount of acid is added to bring pH to 2.9 to 3.1. Layers are allowed to settle for 15 minutes. The lower product layer is transferred to Receiver 1 (**42B, 42C**), keeping the emulsion with the upper aqueous layer. Estimated time - 3 hours (**42D**).

(qq)   300 L of solvent is added to the aqueous layer in STILL2 (**43A**). Agitated for 15 minutes at 5-10^{0}C, pH is checked by taking sample. Solution is adjusted to pH 2.9 to 3.1 with a small amount of acid. Layers are allowed to settle for 15 minutes. The lower product layer is transferred to Receiver 1 (**43B, 43C, 43E**, Blowlines), keeping the emulsion with the upper aqueous layer. Estimated time - 2 hours (**43D**: Sweep).

(rr)   The aqueous layer in STILL 2 is checked for pH by taking a sample. pH is adjusted above 7 with 50% caustic soda solution. The neutralized aqueous layer is pressure transferred to aqueous waste tank for treatment. Estimated time - 0.5 hours.

(ss)   The solvent solution in Receiver 1 is pressure (**45B**) transferred to STILL 1 (**45A**). STILL 1 is set for vacuum, distillation, to Receiver 1. Estimated time - 2 hours (**45C**: Sweep).

(tt)   STILL 1 contents are vacuum distilled (**46A, 46B**) to a residue of 318 to 325 kg using 80^{0}C maximum jacket temperature. Estimated time -11 hours.

(uu)   Jacket temperature is set to 70^{0}C and vacuum in STILL 1 is broken to atmospheric pressure with nitrogen.

(vv)   To the distillate in Receiver 1 is added 125 L of purified water (**48A**) and 50% caustic soda solution to bring pH to 7 or greater. pH is checked. Layers are allowed to settle. Lower solvent layer is pumped to the organic waste tank (**48C**). Upper layer is pumped to the aqueous waste tank. Estimated time - 1 hour (**48B**: Sweep).

(ww)   300 L of solvent is added to residue in STILL 1 (**49A**) and heated to the temperature (**49B**) where the vapor pressure of the solvent is approximately 300 mmHg, and agitated until solids are dissolved. Estimated time - 1.5 hours (**49C**: Sweep).

(xx)   Jacket temperature on STILL 1 is set to temperature of Step (ww). After all solids are dissolved, the solution is filtered through a Sparkler type filter press (on recirculation until solution is clear), is pumped to Receiver 1 (**50A**). Filter press is precoated with Hyflo Super Cel. STILL 1 (**50B**), filter press and lines are rinsed with solvent to Receiver 1 (pressure transfer (**50F**) and blow lines (**50D**)). About 80L of solvent is used. Estimated time - 2 hours (**50E**: Sweep- S1 8R1).

(yy)   Agitation on Receiver 1 is adjusted to 50 rpm. Solvent solution is cooled to temperature where solvent vapor pressure is approximately 100 mmHg. If crystallization has not occurred at that temperature, material is seeded by adding solids. Agitation continues for 1 hour at the same temperature. Estimated time - 3 hours (**51**: Sweep).

(zz)   Over a 12 hour period, batch is cooled to temperature where solvent vapor pressure is approximately 25 mmHg. Cooling continues over 90 minutes to temperature where solvent vapor pressure is approximately 5 mmHg. Continue agitation for the next 2 hours at the same temperature. Estimated time - 15.5 hours (**52**: Sweep).

(aaa)   Crystal slurry is pressure transferred to a centrifuge (**53E**-R1). Crystals are washed with chilled (53G, **53F**-R1) solvent. Estimated time - 4 hours. Filtrate is collected in STILL 2 (**53A**)(**53B**: Sweep-R1, **53C**:Sweep-S2, **53D**:Sweep-CF).

(bbb)   Receiver 1 and lines are rinsed (**54A, 54B**) to a centrifuge with 75L of solvent (pressure transfer (**54C**) and blow lines (**54E**)). Estimated time - 0.5 hour (**54D**: Sweep R18S2).

(ccc)   500 L of purified water is added to STILL 2 (**55A**) and pH is adjusted with 50% caustic soda solution to pH 7 to 10. Sampling for pH adjustment is done. Layers are allowed to settle for 30 minutes. Estimated time - 1 hour (**55B:** Sweep).

(ddd)   The lower layer is pumped to aqueous tank. The upper solvent layer is pumped to organic waste tank for treatment (**56A**). Estimated time - 1 hour (**56C**: Sweep).

(eee)   Wet cake is transferred from centrifuge to vacuum dryer where products is dried at 35^{0}C (Product temperature) to a moisture balance of 0.5% or less. Estimated time - 12 hours.
         57: Drying   Mass Balance   Initial: 70% wet   400kgs.
                                           Final: 0.5% wet   120 kgs.

(fff)   Dry product is drummed in fiber drums. Estimated time - 6 hours.

Emission Calculations:

(a)   STILL Tank 613 in Bldg T31 (500 gallons) Emissions:

(1)   CO Emissions:
CO Emission was based on test data from process with the worst CO emissions. The test data was performed on a 1:20,000 scale basis for a process run in a 2000 gallon scale building. Process uses a 63.5 grams of $COCl_2$. Assume all is converted to CO.

CO/lot	=	63.5 g $COCl_2$/lot * gmol $COCl_2$ /98.92 g * gmol CO/gmol $COCl_2$ * 28 g CO/gmol CO * lb/454 g
	=	0.0396 lb CO/lot

CO Emission	=	0.0396 lb CO/lot * 20,000 bldg size/sample size * 100 lots/yr * 500 gallons/2000 gallons * ton/2000 lbs
	=	9.9 tons/year

(2)   SO2 Emissions:
Based on worst case SO2 emitting process.
100 lots/yr for processes emitting SO2 in Bldg T31. Assume all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits SO2 will run in Bldg T31. Since process stoichiometry is based on bulk facility building scale, scaled emissions from all processes to appropriate size of the new tanks.

$SOCl_2 + H_2O \, 6 \, SO_2 + 2HCl$
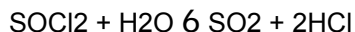
SO2/lot	=	1023 kg $SOCl_2$/lot * kgmol $SOCl_2$/118.97 kg * kgmol SO_2/kgmol $SOCl_2$ * 64.06 kg SO_2/kgmol SO_2 * 2.2 lb/kg
	=	1,212 lb SO2/lot (for a 2,000 gallon tank)

SO2 Emission	=	1,212 lb SO2/lot * 100 lots/yr * 500 gal/2,000 gal * ton/2000 lbs
	=	15.15 tons/ year

(3)   NOx Emissions:
Based on the worst case NOx emitting process.
100 lots/yr for processes emitting Nox in Bldg T31. Assumed all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits NOx will run in Bldg T31. Since process stoichiometry is based on bulk facility building scale, scaled emissions from all processes to appropriate size of new tanks.

Reaction 1:
$NaNO_2 + HCl \, 6 \, HNO_2 + NaCl$
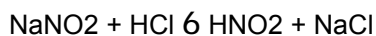
92.3 kg NaNO2 will be reacted with HCl, therefore:
92.3 kg NaNO2 (1000 g/kg)(mol/69 g $NaNO_2$ =   1338 mol NaNO2

1338 mol NaNO2 yields 1338 mol HNO2

Reaction 2:

N-NH2 + HNO2 6 H-H + N2O + H2O
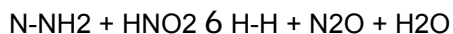
Only half of the 1338 mol HNO2 available reacts. Therefore, 669 mol of N2O are formed, 669 mol of HNO2 remain. Nitrous oxide (N2O) is stable and inert.

Total NO2 Formed:

669 mol NO2　　6　　669 mol NO2

Formed from unreacted HNO2　NO2 evolved/lot

Lb NOx/lot	=	669 mol NO2/lot * 46.01 g/molNO2 * lb/454 g * 100 lots/yr
	=	6780 lb/lot
NOx Emission	=	6780 lb NOx/lot * 500 gal/2000 gal * ton/2000 lb
	=	0.85 tons/yr

(4)　Inorganic HAP Emissions:
Based on worst case inorganic HAP emitting process (emits 1829 lb HCl per lot from a 4,000 gallon tank). Maximum production capacity is based on producing 50,000 kilos of final product per year.

HCl Emission	=	1,829 lb HCl/lot tech * 500 gal/4,000 gal * 1 lot tech/1,108 bkg tech * 1.152 bkg tech/1 kilo final * 50,000 kilos/yr * ton/2000 lbs
	=	5.94 tons/yr

(b)　Process Vessel REAC 3205 in Bldg T29 (2,000 gallons) Emissions:

(1)　Inorganic HAP Emissions:
Based on worst case inorganic HAP emitting process (emits 1829 lb HCl per lot from a 4,000 gallon tank). Maximum production capacity is based on producing 50,000 kilos of final product per year.

HCl Emission	=	1,829 lb HCl/lot tech * 2,000 gal/4,000 gal * 1 lot tech/1,108 bkg tech *1.152 bkg tech/1 kilo final * 50,000 kilos/yr * ton/2000 lbs
	=	23.77 tons/yr

(a) Process Vessel REAC 3205:

Fugitive Emissions Component	Number of Components	Uncontrolled Emissions		Controlled Emissions			
		SOCMI Emission Factor (lb/hr/component	Daily Emissions (lb/day)	LDAR Factors (lb/hr/component	Daily Emissions (lb/day)	Annual Uncontrolled Emissions (tons/yr)	Annual Controlled Emissions (tons/yr)
Tank Flanges	32	0.00183	1.4054	0.000697	0.5353		
Pumps & Agitators	0	0.108908	0.0000	0.004969	0.0000		
Liquid valves	0	0.015653	0.0000	0.001459	0.0000		
Vapor Valves	0	0.012346	0.0000	0.000309	0.0000		
Press Relief Valves	0	0.229281	0.0000	0.229281	0.0000		
Total VOC Fugitive Emissions			1.4054		0.5353	0.2565	0.0977

(b)   STILL Tank 613:

Fugitive Emissions Component	Number of Components	Uncontrolled Emissions		Controlled Emissions			
		SOCMI Emission Factor (lb/hr/component	Daily Emissions (lb/day)	LDAR Factors (lb/hr/component	Daily Emissions (lb/day)	Annual Uncontrolled Emissions (tons/yr)	Annual Controlled Emissions (tons/yr)
Tank Flanges	10	0.00183	0.4392	0.000697	0.1673		
Pumps & Agitators	1	0.108908	2.6138	0.004969	0.1193		
Liquid valves	15	0.015653	5.6351	0.001459	0.5252		
Vapor Valves	5	0.012346	1.4815	0.000309	0.0371		
Press Relief Valves	1	0.229281	5.5027	0.229281	5.5027		
Total VOC Fugitive Emissions			15.6723		6.3516	2.8602	1.16

	SUMMARY OF EMISSIONS (TONS/YEAR)					
Proposed Facility	VOC & Organic HAPs		CO	SO2	NOx	Inorganic HAPs
	Uncontrolled Emissions	Controlled				
T29 Process Vessel REAC 3205 (2,000 gal) *	28.64	1.45				23.77
REAC 3205 Fugitive Emissions	0.26	0.097				
T31 Still Tank 613 (500 gal)	7.35	0.74	9.9	15.15	0.85	5.94
T31 Still Tank 613 Fugitive Emissions	2.86	1.16				
TOTAL	39.11	3.45	9.9	15.15	0.85	29.71

* The VOC emissions from Process Vessel REAC 3205 is destroyed at 95% and the Lilly LDAR program is implemented to reduce fugitive emissions.

** The point source emissions from all VOC emitting equipment (except portable charge tanks) that are not subject to 326 IAC 8-5-3 in Buildings T31 and T31A are controlled at 90%.

T31/31A GENERAL ORGANIC SYNTHESIS MANUFACTURING PROCESS STEPS

STILL 1	VOC EMISSIONS	STILL 2	VOC EMISSIONS
1A	1.94	9A	"0.62
1B	0.14	9C	"0.01
1C	0.15	9D	"0.30
1D	0.06	9E	"4.2
1E	0.04	10A	"0.07
3A	0.16	10D	"0.63
3B	0.27	13C	"1.45
3C	4.2	13F	"0.11
4A	1.88	13I	"0.32
4B	0.29	13J	"4.2
4C	0.09	15A	"0.18
5B	0.25	15C/D	"0.1
7A	0.21	15F	"0.36
9B	2.6	15G	"4.20
13A	1.43	16B	"2.0
13B	0.14	16C	"2.6
13D	2.6	16D/E	"0.29
13E	0.11	16F	"2.6
13G	2.6	21A	"1.89
13H	0.48	21C	"0.32
26A	0.12	21D	"4.2
26B	0.08	22D	"7.87
27A	0.54	22B	"63.21
27D	2.6	25A	"4.64
27E	0.06	25B	"0.65
27F	0.06	29B	"3.3
28A	0.39	30A	"0.12
28B	0.16	30D	"2.6
28C	0.36	"39	"1.09
"29	2.45	41A	"1.5
30B	0.12	41C	"2.6
30C	4.2	41D(1/2)	"0.2
33A	0.13	42B	"0.68
34B	0.08	42C	"2.6
34C	4.2	42D	"0.40
34E	0.08	43A	"0.47
35*	183.67*	43C	"2.60
35B	0.1	43D(1/2)	"0.33
36A	0.15	53A	"0.85
36B	0.19	53C	"1.94
36C	35.47	53G	"0.33
36D	0.25	" 54	"4.2
36I	0.84	54B	"0.12
38A	0.29	54D/55B	"0.32
38B	0.01	55A	"1.37
40A	0.16	55B	"0.32
40B	0.62	56C	"0.32
45A	2.58	LB/LOT	"135.28
45C(1/2)	0.33	TPY	"6.76
46A	0.29		
46B	75.58		
49A	1.4		
49B	0.32		
49C	0.94		
50B	0.18		
50E	1.26		
50F	2.6		
LB/LOT	158.83		
TPY	7.94		

* Ozonolysis step emissions

   TPY = lb/lot * 400 lot/yr * ton/2000 lb * 1/4 modules

Emissions from STILLs:

STILL Tank = average emissions from STILL 1 and STILL 2

      = (7.94 tons/yr + 6.76 tons/yr) / 2

      = 7.35 tons/yr

REGULATED AND HAP POINT SOURCE EMISSIONS FOR BLDG. T29

| EQUIP. ID | POTENTIAL EMISSIONS (TONS/YR) | | | | | HAPS | | |
	VOC	NOX	CO	SO2	PARTICULATE	ORGANIC	INORGANIC	TOTAL
CENT 1401	0.2					"0.2	24.00	24.200
CENT 2401	0.2					"0.2	24.00	24.200
CENT 3401	0.2					"0.2	24.00	24.200
DRYR 1501	2.9				1.1	"2.9	2.40	5.300
DRYR 2502	2.9				1.1	"2.9	2.40	5.300
DRYR 3501	2.9				1.1	"2.9	2.40	5.300
IBC 8251	0					"0.0	0.00	0.000
REAC 1201	1.4					"1.4	24.00	25.400
REAC 1202	1.4					"1.4	24.00	25.400
REAC 1203	1.4					"1.4	24.00	25.400
REAC 1204	1.4					"1.4	24.00	25.400
REAC 1205	1.4					"1.4	24.00	25.400
REAC 2201	1.4					"1.4	24.00	25.400
REAC 2202	1.4					"1.4	24.00	25.400
REAC 2203	1.4					"1.4	24.00	25.400
REAC 2204	1.4					"1.4	24.00	25.400
REAC 2205	1.4					"1.4	24.00	25.400
REAC 3201	1.4					"1.4	24.00	25.400
REAC 3202	1.4					"1.4	24.00	25.400
REAC 3203	1.4					"1.4	24.00	25.400
REAC 3204	1.4					"1.4	24.00	25.400
REAC 3205	**1.4**					**"1.4**	**24.00**	**25.400**
REAC 4201	1.4					"1.4	19.2	20.6
REAC 4203	1.4					"1.4	24.00	25.400
TK 7902	0					"0.0	0	0
TK 8211	0					"0.0	1.2	1.2
TK 8212	0					"0.0	1.2	1.2
TK 8213	0					"0.0	1.2	1.2
TK8214	0					"0.0	1.2	1.2
TK 8216	0					"0.0	0	0
BDS 7103					0.1			
BDS 7104					0.3			
TOTAL	33.7				3.6	33.7	24	57.7
FUGITIVES	60.4					60.4		60.4

note: VOC emissions from centrifuge filtrate tanks and dryer filtrate tanks emissions were accounted for in centrifuge and dryer systems, repectively.

REGULATED AND HAP POINT SOURCE EMISSIONS FOR BLDG. T31, T31A EXPANSION

EQUIP. ID	POTENTIAL EMISSIONS (TONS/YR)								HAPS		
	VOC	NOX	CO	SO2	PARTICULATE	OTHER TRS	OTHER H2S	OTHER RED. SULFUR	ORGANIC	INORGANIC	TOTAL
T31A SOURCES											
STILL TANK 681	0.7	0.9	9.9	15.5					"0.7	6.00	6.700
RECEIVER TANK 682	0.2								"0.2	6.00	6.200
STILL TANK 683	0.7	0.9	9.9	15.2					"0.7	6.00	6.700
RECEIVER TANK 684	0.2								"0.2	6.00	6.200
STILL TANK 691	0.7	0.9	9.9	15.2					"0.7	6.00	6.700
RECEIVER TANK 692	0.2								"0.2	6.00	6.200
STILL TANK 693	0.7	0.9	9.9	15.2		0.9	0.2		"0.7	6.00	6.700
RECEIVER TANK 694	0.2								"0.2	6.00	6.700
CENTRIFUGE 25	1.1								"1.1	24.00	25.100
CENTRIFUGE 05	1.1								"1.1	24.00	25.100
HEINKEL CENTRIFUGE	1.1								"1.1	24.00	25.100
ROTARY VACUUM DRYER 8	1.7				0.0				"1.7	2.40	4.100
ROTARY VACUUM DRYER 28	1.7				0.0				"1.7	2.40	4.100
TANK 688	0.1								"0.1	1.50	1.600
T31 SOURCES											
RECEIVER TANK 602	0.2								"0.2	6.00	6.200
STILL TANK 601	0.7	0.9	9.9	15.2					"0.7	6.00	6.200
STILL TANK 603	0.7	0.9	9.9	15.2					"0.7	6.00	6.200
RECEIVER TANK 604	0.2								"0.2	6.00	6.200
RECEIVER TANK 611	0.2								"0.2	6.00	6.200
STILL TANK 612	1.7	0.9	9.9	15.2					"1.7	6.00	7.700
STILL TANK 613	**0.7**	**0.9**	**9.9**	**15.2**					**"0.7**	**"6.0**	**6.7**
RECEIVER TANK 614	1.1								"1.1	6.00	7.100
STILL TANK 631	0.7	0.5	5.9	9.1					"0.7	3.6	4.3
RECEIVER TANK 641	0.2								"0.2	1.2	1.4
RECEIVER TANK 643	0.2								"0.2	1.2	1.4
CENTRIFUGE 901	1.1								"1.1	24	25.1
COLUMN BOTTOMS TANK	0.5								"0.5	1.2	1.7
TANK 609	0.1								"0.1	1	1.1
TANK 669	0.1								"0.1	1	1.1
PORTABLE SOURCES											
FILTER/DRYER	0.5				0				"0.5	2.4	2.9
FILTER DRYER	0.3				0				"0.3	2.4	2.7
FILTER DRYER	0.1				0				"0.1	2.4	2.5
PAN DRYER	0.1				0				"0.1	2.4	2.5
VACUUM SHELF DRYER	1.7				0				"1.7	2.4	4.1
MICROWAVE VACUUM DRYEI	0				0				"0.0	2.4	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	1.2								"1.2	1.2	2.4
CHARGE TK	0.6								"0.6	0.6	1.2
CHARGE TK	0.6								"0.6	0.6	1.2
CHARGE TK	0.6								"0.6	0.6	1.2
CHARGE TK	0.2								"0.2	0.2	0.5
CHARGE TK	0.1								"0.1	0.1	0.2
T31A EXPANSION											
REACTOR TANK 661	0.1								"0.1	3.6	3.7
TANK 621	"0.0								"0.0	3.6	3.6
TANK 622	"0.0								"0.0	9.6	9.6
TANK 623	"0.0								"0.0	4.8	4.8
TANK 624	"0.0								"0.0	3.6	3.6
TANK 625	"0.0								"0.0	3.6	3.6
TANK 626	"0.0								"0.0	"6.0	"6.0
FILTER/DRYER FD-861	0.1				0				"0.1	2.4	2.5
TANK 861 K	"0.0								"0.1	1.2	1.3
TANK 451 K	"0.1								"0.1	1.2	1.3
TANK 651	"0.2								"0.2	5.4	5.6
TANK 652	0.2								"0.2	5.4	5.6
TOTAL	120.88								120.88		120.88

Note: Point source totals for NOx, CO and SO2 are not equal to the sum of the individual point source.
See text for explanation.